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SOME POLYCLADS OF THE NEW ENGLAND COAST,
ESPECIALLY OF THE WOODS HOLE REGION

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This report is based on polyclads collected at Woods Hole, Massachusetts, Mt. Desert Island, Maine, Connecticut and Long Island, New York. I believe it includes practically all of the species expected to occur in the neighborhood of Woods Hole. The Woods Hole specimens were personally collected in the summer of 1935 or were loaned for identification by Mr. George Gray, Curator of the Museum of the Marine Biological Laboratory. The Peabody Museum of Yale University kindly loaned some specimens collected by Verrill along Massachusetts and Connecticut shores. The specimens from Mt. Desert Island, Maine, were personally collected in the summer of 1937. The specimens from Connecticut and Long Island were presented by Dr. Herman Spieth and Mr. M. D. Burkenroad.

Ten species are represented in the material; none of these is new but most of them are interesting as old species badly in need of reworking. Each species has been carefully studied whole and in serial section to determine its status according to modern taxonomic standards. It is gratifying to me to be able to clear up the taxonomic position of some of the old species of Girard and Verrill.

The scheme of classification here adopted is taken from Bock's invaluable treatise (1913) which is fundamental to all modern work on the group.

Before proceeding to the taxonomic descriptions, it seems desirable to give a brief account of the reproductive system of polyclads, since this system is of paramount importance in many genera. Polyclads are hermaphroditic with numerous testicular and ovarian follicles scattered throughout the parenchyma; there are no yolk glands. Fine vasa efferentia connect the testes to the paired vasa deferentia, expanded, thin-walled, usually sinuous canals, packed with sperm. These separately or after a union enter the male copulatory apparatus, which typically consists of seminal vesicle, prostate or granule vesicle, and penis. The seminal vesicle is a rounded, oval or curved sac with a thick muscular

wall. In some cases (*Stylochus* in part, some species of *Notoplana*) the terminal parts of the vasa deferentia acquire muscular walls and entirely resemble the seminal vesicle, so that a tripartite seminal vesicle results (Fig. 1). Certain glands known as granule (German workers) or prostate (English workers) glands are constantly associated with the male apparatus of polyclads. They may open directly into the terminal part of the male canal but more often are associated into a definite rounded or oval body with a muscular wall, termed the granule or prostate vesicle. The granule glands are often included inside this vesicle or may open into it from the exterior (extracapsular glands of Bock) or both. The granule vesicle may form a direct part of the male canal so that the sperm must pass through its lumen as in the Leptoplanidae (Fig. 5); this condition of the vesicle will here be termed "interpolated" ("eingeschaltet" in German). In some acotylean families and in the Cotylea in general the granule vesicle is "free," that is, connects by a duct to the male canal (Fig. 1). The function of the granule glands is unknown but the secretion is ejaculated with the sperm and must be of importance in their physiology. After passing through or receiving separately the granule vesicle, the male duct enters the penis proper, typically having the form of a projecting conical muscular papilla. It is frequently provided with a long or short hard stylet, sometimes curved or coiled, and may then itself be much reduced. The penis papilla may project directly into the male atrium or antrum or it may be at the inner end of a long canal leading from the atrium; this canal is termed by Bock the penis pocket (Fig. 5). When a penis pocket is present there may be at the place where the pocket widens into the male atrium, a penis-like projection, the penis sheath. In the family Planoceridae there is no proper penis but instead a cirrus, armed with teeth or spines. Penis here is limited to a male copulatory organ which is simply protruded by muscular action; cirrus means a copulatory organ which is everted when used so that the lining is turned to the outside.

The ripe eggs commonly collect in paired thin-walled expanded canals, the uteri, which in the family Leptoplanidae unite in front of the pharynx. The uteri, separately or after a union, open into the common unpaired female canal which then proceeds to the genital pore. This canal from the genital pore to the entrance of the uteri is commonly muscular and receives innumerable cement glands; Bock terms it vagina since it must serve for copulation in most polyclads. It is also the passage by which the eggs reach the exterior. Near the genital pore it may be widened into a cement pouch into which most or all of the cement glands open. The cement glands secrete the material by which the eggs are fastened into ribbons or masses and stuck to objects. In many poly-

clads the female canal continues inward proximal to the entrance of the uteri and terminates in a small or large spherical, oval, or tubular sac, now known as Lang's vesicle (Fig. 5). This appears to be a seminal receptacle since sperm are often seen in it.

The male apparatus is always anterior to the female apparatus. The genital pores are commonly separate but may be united. Paired or multiple male apparatuses are not uncommon.

SUBORDER ACOTYLEA LANG 1884

Definition.—Polyclads without a sucker behind the female genital pore; pharynx ruffled; copulatory apparatuses behind the middle of the body; tentacles when present of the nuchal type; uteri anterior to the female genital pore.

SECTION CRASPEDOMMATA BOCK 1913

Definition.—Acotylea with marginal eyes, in addition to the usual cerebral and tentacular eyes.

FAMILY STYLOCHIDAE STIMPSON 1857 (EMEND. BOCK, 1913)

Definition.—Craspedommata with a band of eyes along the whole or part of the body margin; female or both genital pores very near the posterior end; granule vesicle free; tentacles generally present; body usually oval, thick, firm and opaque.

GENUS STYLOCHUS EHRENBURG 1831 (EMEND. LANG 1884)

Definition.—Stylochidae with male and female pores close together in the posterior fourth of the body; tentacles well-developed; pharynx large with well-marked folds; prostate vesicle large, chambered, with extracapsular gland cells; seminal vesicle single or tripartite; Lang's vesicle absent.

STYLOCHUS ZEBRA (VERRILL) 1882

Syn. *Stylochopsis zebra* Verrill 1882.

Stylochus zebra (Verrill) 1892.

Description.—The external features of this familiar Woods Hole polyclad have been adequately described by Verrill (1892). The body is of elongated oval or oblong form, obtuse at each end, of thick and firm texture, reaching a length of 30–40 mm. The dorsal surface has a color pattern of alternating yellowish or white and brown or chocolate cross-bars of which the most anterior and posterior ones are V-shaped. Near the anterior end are two rounded tentacles filled with eyes and between the tentacles are the paired cerebral groups of eyes. These

are loose elongated groups extending behind and before the level of the tentacles. The margin is completely encircled with a band of small eyes, wider in front, diminishing caudally.

Study of sections of the copulatory apparatus proves for the first time that this species was correctly placed by Verrill in the genus *Stylochus*. The uteri and vasa deferentia course alongside the posterior part of the very large, much ruffled pharynx behind the posterior end of which occurs the copulatory apparatus. The rear ends of the vasa deferentia expand and acquire muscular walls as they ascend to join the seminal vesicle proper, producing the three-parted type of seminal vesicle characteristic of several species of *Stylochus* (Fig. 1). The central lobe of this or seminal vesicle proper continues posteriorly as the ejaculatory duct which narrows and becomes less muscular, receiving near the penis the duct of the prostate vesicle. The latter is a large oval chambered sac with thick muscular walls penetrated by the necks of extracapsular granule glands (Fig. 1). The erect position of the prostate vesicle is unusual for the genus; the vesicle is commonly horizontal. After receiving the prostatic duct the ejaculatory duct continues through the penis, a simple conical projection into the small male atrium. The latter opens below by the male genital pore. Shortly behind this occurs the female genital pore, from which the muscular ciliated vagina extends dorsally, then curves posteriorly and downward to terminate where it receives the uteri (Fig. 1). A Lang's vesicle is absent as in the genus in general.

The color pattern and the erect prostatic vesicle serve to distinguish this species from others of the genus.

Distribution.—Region of Woods Hole, on wharves and pilings and along shores; also found by Verrill at other places in Vineyard Sound and in Long Island Sound, near New Haven, Conn., in dead shells of *Sycotypus* occupied by hermit crabs.

STYLOCHUS ELLIPTICUS (GIRARD) 1850, NEW COMB.

Syn. *Planocera elliptica* Girard 1850.

Stylochopsis littoralis Verrill 1873.

Stylochus littoralis (Verrill) Lang 1884.

Eustylochus ellipticus (Girard) Verrill 1892.

I am fortunately able to give a description of this species and establish its correct systematic position. There are available two vials of Verrill's collecting, a specimen in the Woods Hole material, and a number of individuals presented by Dr. Spieth and Mr. Burkenroad whom I here wish to thank for their trouble. Study of this material proves that

the animal is a typical member of the genus *Stylochus* and hence that Verrill was in error in erecting a new genus *Eustylochus* for the species (Verrill, 1892). *Eustylochus* thus becomes a synonym of *Stylochus*.

Description.—*S. ellipticus* (Fig. 2) is of oval or elliptical form and may reach a length of 20–25 mm.; specimens as small as 4 mm. were found to have the male system fully developed but the female system was immature. The body is flat but somewhat thick and opaque with undulated margins. The color is stated by Verrill and others to be various shades of cream, yellow, or brown, veined or reticulated with a lighter shade, or freckled with golden brown on a lighter ground color; the periphery is clear and translucent and there is usually a light cream to brown stripe in the posterior middorsal region. There are two nuchal tentacles filled with eyes; these are probably elongated and pointed in life but in the preserved specimens were rounded and somewhat sunk into depressions. Between and in front of the tentacles occur the cerebral eyes, subject to much variation. Not infrequently these occur in two pairs of groups of two eyes each (Fig. 2), but often there are three to five or more (up to nine were seen) eyes in each of the four groups and there may be a few scattered eyes farther back over the brain. Specimens have also been seen in which the cerebral eyes were not definitely arranged in four groups but formed a loose band on each side. A band of eyes occurs along the margin of the anterior third to half of the body; these eyes are larger in the mid-anterior region and diminish in size and number around the sides of the body. In many specimens no eyes could be seen along the margin of the posterior half or two-thirds of the body but in some individuals there are a few small eyes scattered along this region so that the entire margin in such cases is encircled with eyes.

The pharynx is of moderate size, smaller proportionately than in *Stylochus zebra* but well folded. The branches of the digestive tract radiate to the periphery making a reticulum through numerous anastomoses between adjacent branches.

Study of the copulatory apparatus in serial sections (Fig. 3) shows that the species is a typical *Stylochus* and that no grounds exist for separating it into a distinct genus. The genital pores are very close together near the posterior margin. The coiled vasa deferentia run alongside the pharynx and their distal ends turn dorsally and become muscular as they join the seminal vesicle proper. There is thus some development of the tripartite condition of the seminal vesicle seen in several species of *Stylochus*, but the central lobe is here much larger than the lateral lobes formed by the ends of the vasa deferentia. The central lobe tapers posteriorly into the ejaculatory duct which runs beneath the

prostatic vesicle to open into the penis lumen. The prostatic vesicle is a very large oval sac with a chambered interior and a thick muscular wall penetrated by the necks of extracapsular granule glands which discharge into the chambers of the interior. The prostatic vesicle has the horizontal orientation characteristic of the genus. Its duct joins the ejaculatory duct in the interior of the penis and the common duct so formed continues to the penis tip (Fig. 3). The penis papilla is a moderately muscular conical projection armed with a short stylet situated in the lumen. The occurrence of a stylet appears to be unusual in the genus *Stylochus*. The expanded male atrium closely surrounds the penis papilla and exits below by the male genital pore. The lining of the male atrium and the base of the penis papilla are filled with glandular secretion.

The large female pore, situated immediately behind the male pore, is lined by a very tall epithelium also having a glandular border of eosinophilous secretion. The vagina accompanied by cement glands proceeds dorsally and forward as a narrow tube which near the dorsal body wall turns sharply backwards and terminates by receiving the uteri.

Distribution.—Stated by Verrill to occur from New Haven, Conn., to Casco Bay, Maine, under stones in shallow water and tide-pools; not uncommon now at Cold Spring Harbor, Long Island, and along the shores of the west end of Long Island Sound where it joins the East River. Apparently scarce along the Connecticut shore, where four specimens were taken under a rock at Indian Neck, by M. D. Burkenroad. One specimen lent by Mr. Gray came from the bottom of a light-ship, off Woods Hole. Verrill's specimens from the Peabody Museum were as follows: one vial containing six animals, labelled Savin Rock (this is

For all figures the numbers listed below have the same connotations.

1, marginal eyes, 2, tentacles, 3, tentacular eyes, 4, cerebral eyes, 5, brain, 6, pharynx, 7, vasa deferentia, 8, enlarged muscular terminations of the vasa deferentia, 9, seminal vesicle, 10, prostate vesicle, 11, glandular chambers of the prostate vesicle, 12, extracapsular granule glands, 13, penis papilla, 14, ejaculatory duct, 15, prostatic duct, 16, stylet, 17, male genital pore, 18, male atrium, 19, penis pocket, 20, female genital pore, 21, vagina, 22, cement pouch, 23, cement glands, 24, entrance of the uteri into the vagina, 25, uteri, 26, stalk of Lang's vesicle, 27, Lang's vesicle, 28, cirrus, 29, retractor muscle of the cirrus, 30, protractor muscle of the cirrus, 31, musculo-glandular fold of the vagina, 32, main intestine, 33, penis sheath, 34, female genital atrium, 35, granule glands, 36, common genital pore, 37, pouch from genital atrium.

PLATE I

FIG. 1. Copulatory apparatus of *Stylochus zebra*, sagittal view.

FIG. 2. *Stylochus ellipticus*, dorsal view of whole mount.

FIG. 3. *Stylochus ellipticus*, sagittal view of copulatory apparatus.

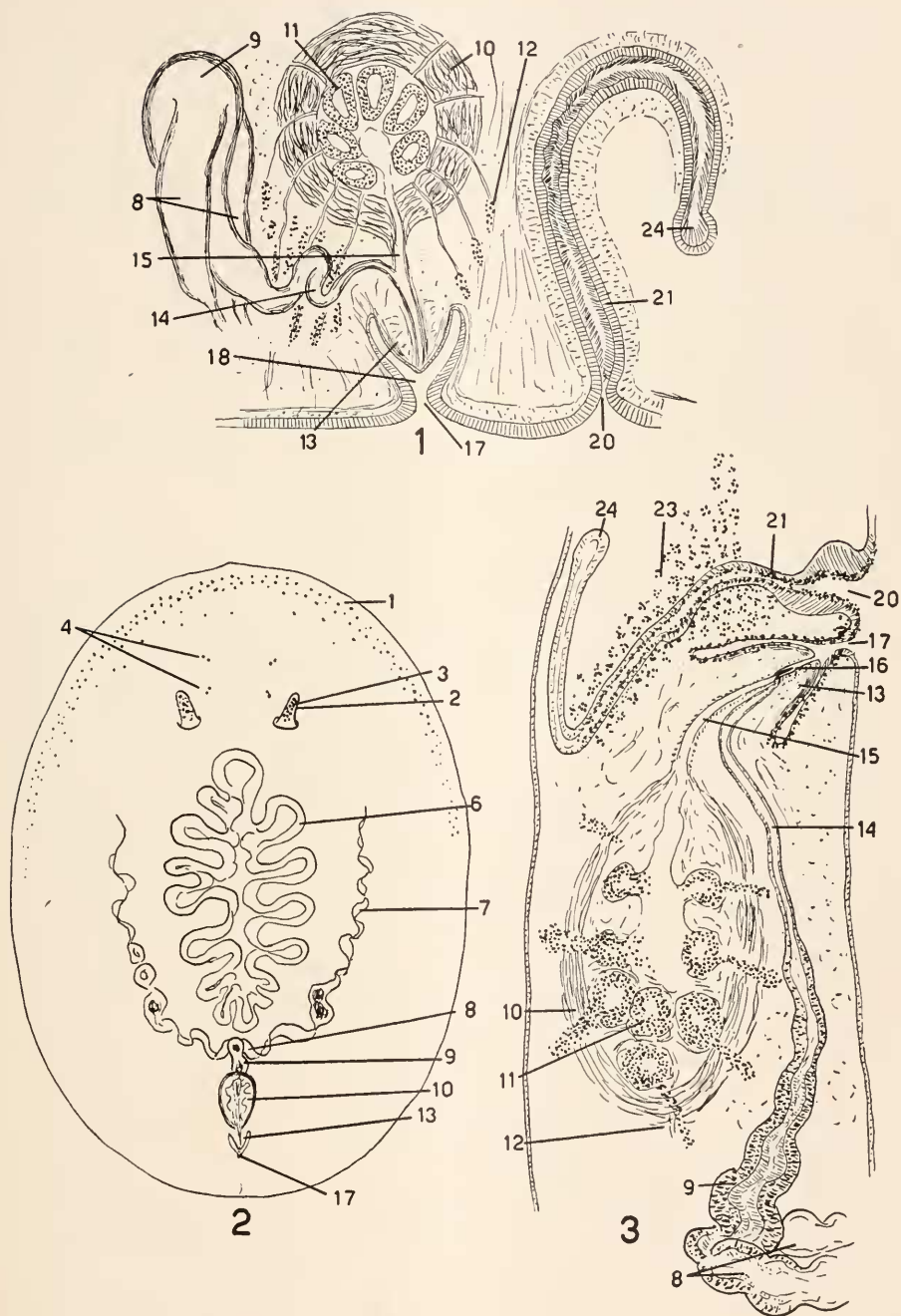


PLATE I

near New Haven), under stones, Oct. 1871; and one vial containing one animal labelled *Stylochus littoralis*, New Haven, Oct. 1872.

SECTION SCHEMATOMMATA BOCK 1913

Definition.—Acotylea without marginal eyes; commonly with paired cerebral and tentacular clusters of eyes close together and far back from the anterior margin.

FAMILY LEPTOPLANIDAE STIMPSON 1857 (EMEND. BOCK)

Definition.—Schematommata with flat thin elongated bodies; prostatic vesicle, when present, interpolated; male apparatus directed backwards; definite tentacles usually absent but may be present; dorsal surface colored, generally some shade of brown; uteri confluent in front of the pharynx.

GENUS NOTOPLANA LAIDLAW 1903

Syn. *Leptoplana* (in part).

Definition.—Leptoplanidae with true seminal vesicle and chambered prostatic vesicle into which the ejaculatory duct penetrates; male apparatus close behind the pharynx, far removed from the posterior margin; penis with or without a stylet; eyes in four clusters; tentacles generally absent or rudimentary.

It has been necessary to limit the genus *Leptoplana* into which it was formerly customary to throw almost any leptoplanid species to the first recognizable species ascribed to *Leptoplana*, namely *L. tremellaris* (O. F. Müller) 1774, and to other species which can be shown to be similar to this species. It unfortunately happens that the anatomy of *L. tremellaris* is somewhat aberrant and hence very few species remain in the genus *Leptoplana*. I know of none on the Atlantic coast of the United States but one occurs in Puget Sound and some may exist on the California coast although most of the Pacific coast species called *Leptoplana* must be transferred to other genera. With this limitation of the genus *Leptoplana*, the majority of the typical leptoplanids fall into the genus *Notoplana*, a genus of many species, all so much alike externally that identification is practically impossible without recourse to serial sections of the copulatory complex. Only one species of *Notoplana* is so far known from the Atlantic coast of North America but many occur on the Pacific coast.

NOTOPLANA ATOMATA (O. F. MÜLLER) 1776

Syn.? *Leptoplana variabilis* (Girard) Verrill 1892.

Description.—This species has already been well described by Bock (1913) and hence I shall be brief. The species, seen at Mt. Desert Island, Maine, may reach a length of 28 mm. and has the typical external aspect of the genus. The elongated ob lanceolate body is broadest across the anterior fourth and then tapers to the rounded posterior end (Fig. 4). Young specimens are even more tapering than fully grown ones. The color is grayish brown above, more or less flecked and streaky. There are the usual four clusters of eyes, two rounded tentacular clusters representing the sites of the aborted tentacles and consisting of 6–10 large eyes and a few small ones; and the elongated cerebral clusters extending forward from the brain and composed of about 15–40 eyes of various sizes, but smaller than the largest of the tentacular eyes. The number of eyes increases with age so that young specimens have few eyes.

The whole anatomy is typically leptoplanid with a central elongated ruffled pharynx, radiating anastomosed digestive branches, uteri encircling the pharyngeal pocket, and vasa deferentia looping backwards across the stalk of Lang's vesicle (Fig. 5). The details of the copulatory apparatus have been discussed by Bock (1913) who presents a sagittal view and I give a ventral view (Fig. 5) made from a pressed live specimen. The vasa deferentia enter separately the angles of the rounded muscular seminal vesicle from which the ejaculatory duct penetrates more than halfway into the lumen of the spherical thick-walled chambered prostatic vesicle. From this the elongated curved penis pocket leads to the male atrium. A very small penis papilla next the prostatic vesicle bears the moderately long curved stylet which occupies the penis pocket and often protrudes from the male genital pore. There is a penis sheath. The wide muscular vagina continues beyond the entrance of the uteri forward, then bends backwards as a narrow stalk terminating in an enlarged Lang's vesicle (Fig. 5).

Bock is of the opinion that *Leptoplana variabilis* is identical with *Notoplana atomata*. While the former is undoubtedly a species of *Notoplana*, I find some points in Verrill's description of it (1892) which do not fit my observations on *N. atomata*. Thus Verrill gives the shape of *L. variabilis* as oblong or elliptical while *N. atomata* is always wedge-shaped, often markedly so, and describes the penis stylet as much longer and more coiled than I have seen it. I have not seen any other shape in a number of specimens examined than the simple bend figured.

Locality.—*Notoplana atomata* appears to be widely distributed along shores of the North Atlantic coast from Scandinavia to Maine; under stones, Mt. Desert Island, Maine, and probably northward.

GENUS EUPLANA GIRARD 1893

Syn. *Discoplana* Bock 1913.

Definition.—Leptoplanidae of somewhat elongated form, without a prostatic vesicle; genital pores close together; tentacles lacking; penis unarmed, mostly small or even absent; Lang's vesicle present or absent. Type: *Euplana gracilis* (Girard) 1850.

I regret the necessity of making Bock's genus *Discoplana* a synonym of *Euplana* but the circumstances leave me no other course.

EUPLANA GRACILIS (GIRARD) 1850

Syn. *Prosthlostomum gracile* Girard 1850.

Prosthlostomum gracile Girard, Verrill 1892.

Euplana gracilis Girard 1893.

A number of specimens of a polyclad considered unnamed by members of the invertebrate staff at Woods Hole were secured in 1935. Study of serial sections revealed that the animal belonged to Bock's genus *Discoplana* and for some time the form was regarded as a new species of *Discoplana*. Then Verrill's figure of *Prosthlostomum gracile* Girard was recognized as identical with the polyclad in question (Verrill, 1892, p. 497). The question then arose whether the species actually is Girard's species, as Verrill thought. It is my opinion that there is very little doubt of this, although Girard was entirely mistaken in placing the animal in *Prosthlostomum*. Later, 1893, Girard recognized this error and created for the species the new genus *Euplana*. This genus appears to be quite valid under the rules and therefore I must regretfully declare *Discoplana* Bock 1913 a synonym of *Euplana* Girard 1893. The correct name of the animal is then *Euplana gracilis* (Girard).¹

PLATE II

FIG. 4. *Notoplana atomata*, from life, dorsal view, Mt. Desert Island, Maine.

FIG. 5. Dorsal view of copulatory apparatus of *Notoplana atomata* as seen in live pressed specimen.

FIG. 6. *Euplana gracilis*, from life, dorsal view, Woods Hole, Mass.

FIG. 7. Another view of the anterior end of *Euplana gracilis*, from life.

FIG. 8. Sagittal section of the copulatory apparatus of *Euplana gracilis*.

¹ If the identity of the species under consideration with *Prosthlostomum gracile* be questioned, then *Discoplana* would again become a valid genus and the animal would be a new species of *Discoplana*.

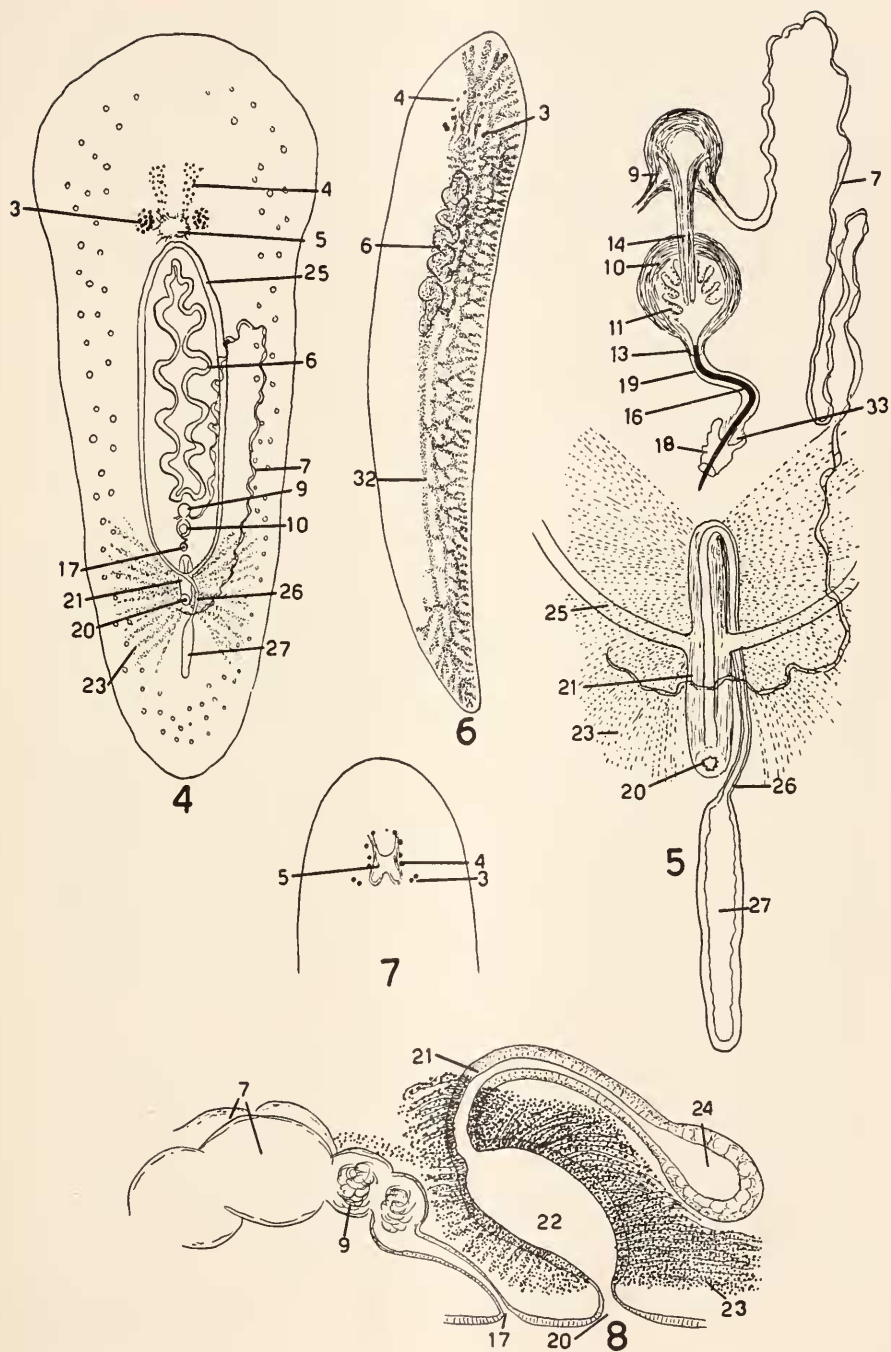


PLATE II

Description.—*E. gracilis* is of slender elongated shape, resembling a fresh-water planarian (Fig. 6). The anterior end is at times somewhat pointed (Fig. 6), at other times rounded (Fig. 7). From the level of the brain the body tapers gradually to the obtuse or rounded posterior end. The species is small, with a maximum length of 8 mm. and of yellowish gray or brownish gray coloration. The eyes are the most distinctive external feature and readily serve to distinguish this species from all other North American polyclads. There are typically six eyes on each side, four in a lengthwise row, representing the cerebral clusters, and two eyes obliquely placed close together, representing the tentacular clusters. Specimens have been seen with some slight irregularity of eye number, such as one or two additional eyes, but the described arrangement is the rule. There are no marginal ocelli as supposed by Verrill.

The small, slightly ruffled pharynx is situated far forward, a position explaining the mistake in placing the species in *Prosthlostomum*. Behind the pharynx the median intestinal trunk is conspicuous in whole mounts (Fig. 6). From this trunk lateral branches extend to the periphery.

The main feature of the copulatory apparatus (Fig. 8) is the absence of the prostatic vesicle. The male and female genital pores are situated close together some distance behind the pharynx at about the middle of the body. Behind the pharynx the expanded thin-walled vasa deferentia unite to a but slightly muscular seminal vesicle which tapers directly to the male genital pore (Fig. 8). There is no penis papilla and no prostate vesicle nor are any extracapsular granule glands discernible in the available material. The female pore shortly behind the male pore leads into an expanded cement pouch into which open great numbers of cement glands (Fig. 8). The vagina then curves posteriorly and ventrally and terminates where it receives the two uteri. There is no Lang's vesicle. The uteri are confluent in front of the pharynx, then course along the sides of the pharynx behind which they expand considerably before joining the vagina.

E. gracilis closely resembles in its sexual anatomy several other species of *Euplana* (= *Discoplana*) differing chiefly in the total absence of a penis papilla.

Distribution.—Found in abundance in the Eel Pond at Woods Hole, Mass., on wharves and pilings among masses of hydroids and sponges; apparently formerly common in Boston Harbor and along the Connecticut shore.

Neotype.—One whole mount; paratype, one set of sagittal sections, deposited in the museum at Woods Hole.

GENUS *STYLOCHOPLANA* STIMPSON 1857 (EMEND. BOCK)

Definition.—Leptoplanidae with true seminal vesicle and non-chambered prostate vesicle, the latter not penetrated by the ejaculatory duct; tentacles present or absent; eyes in paired cerebral and tentacular groups; separate or fused genital pores, which may be near the posterior margin.

In general aspect the species of this genus closely resemble those belonging to *Notoplana*. The essential difference between them lies in the prostate vesicle which is not chambered and not penetrated by the ejaculatory duct.

STYLOCHOPLANA ANGUSTA (VERRILL) 1892

Syn. *Leptoplana angusta* Verrill.

[not *Stylochoplana angusta* (Verrill) Palombi 1928].

The finding at the Peabody Museum of a vial containing three specimens which are undoubtedly "*Leptoplana*" *angusta* has enabled me to determine the systematic status of this species. It was found to be a leptoplanid which fits best into the genus *Stylochoplana* although not entirely conforming to the present conception of this genus. It seems preferable, however, to expand the definition of the genus than to create a new genus for the species.

In 1928 Palombi identified a *Stylochoplana* species obtained by the Suez Canal expedition as *Leptoplana angusta*, and called it *Stylochoplana angusta* (Verrill). This identification is erroneous as the species in question differs decidedly from the latter. Professor Palombi has been informed of the necessity of creating a new specific name for his species.

Description.—*S. angusta* is stated by Verrill to be of elongated elliptical form, thin, with flexible undulated margins, rounded anterior end, and notched posterior margin. Figure 9 is a drawing of a whole mount made from one of Verrill's specimens; the other two were sectioned sagittally. The maximum length is given by Verrill as 12–16 mm., the breadth 4–6 mm., and the color as various shades of light brown. The cerebral and tentacular eyes form a continuous band on each side (Fig. 9), of which the posterior group of larger eyes on either side of the brain undoubtedly represents the tentacular eyes while the band of smaller eyes extending forward from these are the cerebral eyes. The narrow ruffled pharynx is somewhat posterior in position and this presumably accounts for the very posterior location of the copulatory complexes.

There is a large common genital pore close to the posterior margin shortly in front of the notch. This continues into a genital atrium which curves anteriorly receiving the vagina in its dorsal wall and the penis in its anterior wall. The small male copulatory complex (Fig. 10) conforms to that of the genus in general. The vasa deferentia after a union enter the anterior end of the elongated oval seminal vesicle. From this the curved ejaculatory duct runs to the prostatic vesicle. This is of oval form with a thin muscular wall and the interior lined by granule glands. No extracapsular granule glands were seen in the sections; naturally after sixty years in preservative the animals are not in very good histological condition. From the prostate vesicle, the ejaculatory duct continues backward and enters the small pyriform penis which projects into the male portion of the atrium as a slight conical eminence. The very long vagina runs from the roof of the atrium far forward and then after a short backward bend opens into a large spherical Lang's vesicle (Fig. 10). The uteri join the backward bend so that the stalk of Lang's vesicle is very short. The vagina is slightly muscular along its entire course and is accompanied throughout by cement glands. I am unable to determine from my material whether the uteri are confluent in front of the pharynx but Verrill's statements indicate that this is the case. In the whole mount, the uteri are much distended with eggs (Fig. 9) and extend anteriorly beyond the brain, a condition unusual in the Leptoplanidae.

The two sets of sagittal serial sections are identical except for one very puzzling feature. In one of them, the larger of the two, the common genital atrium continues dorsally behind the vaginal entrance as a wide pouch (Fig. 10), which appears to open on the dorsal surface, presumably into the posterior notch. The specimen is unfortunately imperfect at this place so that I cannot be sure of the actual presence of an opening there; but all appearances indicate that this is the case and I have so drawn the region in question (Fig. 10). The second specimen (Fig. 11) shows no trace whatever of such a pouch although it appears to be quite mature sexually. More material will be necessary to settle the matter of the occurrence and relations of the pouch in question. It may represent a ductus vaginalis, as in Bock's genus *Ceratoplana* (Bock, 1925).

Sty. angusta differs from the typical members of the genus in the far posterior location of the genital pore and the forward course of the vagina. The first point is not of so much importance since Bock (1924) found a Japanese species which he assigned to *Stylochoplana* and which also has a very posterior common genital pore. Kato (1937) reports

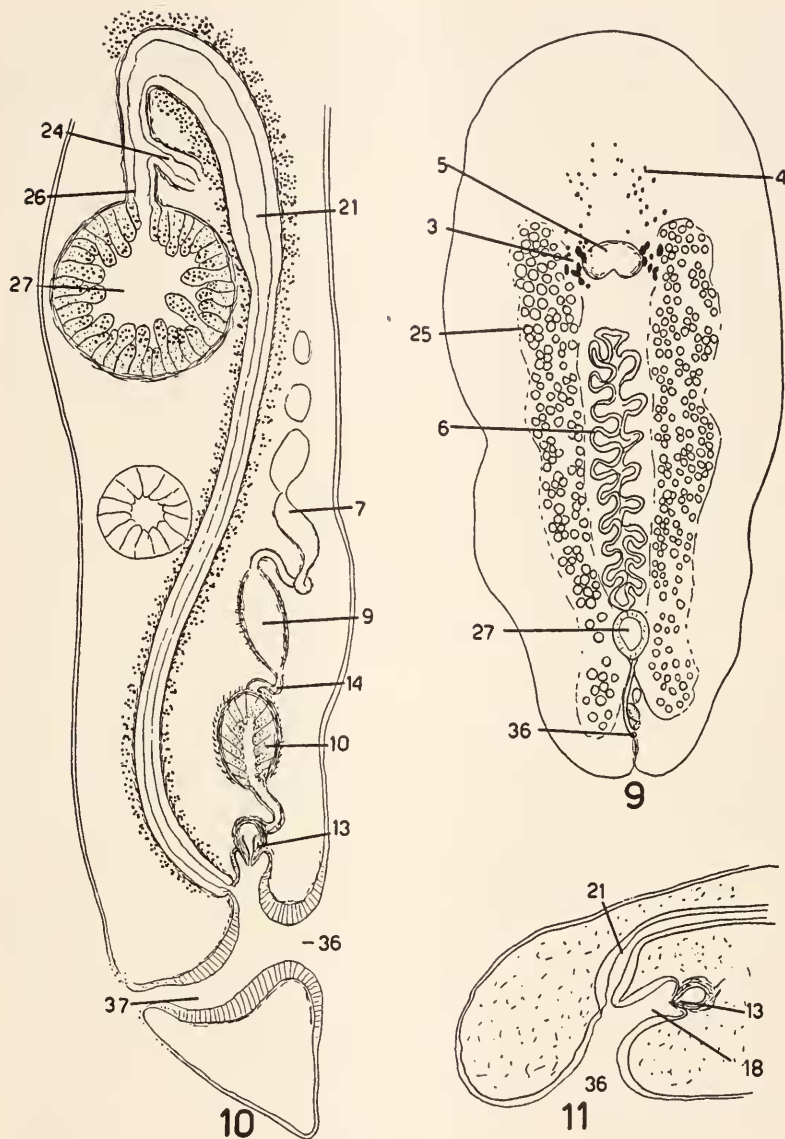


PLATE III

FIG. 9. *Stylochoplana angusta*, dorsal view of whole mount, neotype.

FIG. 10. Sagittal view of the copulatory apparatus of *Stylochoplana angusta*, from one of the sets of serial sections, showing problematical pouch from genital atrium dorsally.

FIG. 11. Terminal part of the copulatory apparatus of *Stylochoplana angusta*, from the second set of serial sections, showing absence of a pouch.

another Japanese *Stylochoplana* having the same feature. But in these species, the vagina, despite the posterior situation of the genital pore, makes the usual backward bend, so that Lang's vesicle lies well behind the genital pore. The situation found in *Sty. angusta* with the long anterior extension of the vagina and the location of Lang's vesicle much anterior to the male apparatus appears to be unique. One could consider it a basis for the erection of a new genus but I prefer to leave the species in *Stylochoplana*, at least for the present.

Distribution.—*Stylochoplana angusta* was found by Verrill at Provincetown, Mass., 1879, on the bottom of a whaling vessel recently arrived from the Carolina coast. The polyclad probably came from this region, especially as it was associated with other animals said by Verrill to be southern. The vial from the Peabody Museum contained a label on which was printed: Off Cape Cod, U. S. F. C. 1879, and written: *Leptoplana*, vessel bottom.

Neotype.—Whole mount designated as neotype; one set of sagittal serial sections, designated as paratype; both deposited in the Peabody Museum, Yale University.

GENUS HOPLOPLANA LAIDLAW 1902

Syn. *Planocera*, Group B, Lang 1884.

Definition.—Schematommata without a true seminal vesicle or penis papilla; ends of the vasa deferentia enormously enlarged into thick-walled muscular tubes serving as accessory seminal vesicles; penis stylet fastened directly to the prostate vesicle; tentacles present; with cerebral and tentacular eye clusters, the latter closely embracing or in the tentacle bases; no Lang's vesicle; shape oval or rounded.

In 1902 Laidlaw rightly removed some of Lang's species of *Planocera* to a new genus *Hoploplana*, which does not even belong to the family Planoceridae. It also does not entirely fit into the family Leptoplanidae, so that Bock (1913) left it as an appendix to the latter. It would seem to me desirable to place *Hoploplana* in a family by itself despite the fact that its affinity to the Leptoplanidae is indicated by the finding in Puget Sound of a species of *Notoplana*, *N. segnis* Freeman 1933, which has also very enlarged, highly muscular terminations of the vasa deferentia.

HOPLOPLANA GRUBEI (GRAFF) 1892

Syn. *Planocera grubei* Graff 1892.

This species, common on the Sargassum, has been adequately described and figured by von Graff (1892). Three specimens, brought

to me for identification by Dr. Hadley of the Invertebrate staff at Woods Hole, were taken from the Sargassum in Vineyard Sound, August 3, 1938. The coloration was stated to consist of gray reticulations on a pinkish-brown or flesh ground. M. D. Burkenroad of the Peabody Museum, who has collected a number of specimens of this species from the Sargassum in the Gulf of Mexico and North Atlantic, reported the color as consisting of livid white reticulations on a brown ground. It is clear that von Graff's conception of the color, based on preserved material, is erroneous. Preserved specimens give no idea of the original coloration. A colored figure of this species made by Dr. J. F. G. Wheeler of the Bermuda Biological Station is being published in my article on the polyclads of Bermuda and the Sargassum (Hyman, 1939).

HOPLOPLANA INQUILINA (WHEELER) 1894

Syn. *Planocera inquilina* Wheeler 1894.

Hoploplana inquilina (Wheeler) Bock 1913.

This species, familiar at Woods Hole, was rightly removed by Bock to the genus *Hoploplana*. Wheeler presents an excellent figure of the entire animal but his account of the internal details leaves much to be desired. I have therefore deemed it necessary to make a study of serial sections.

Description.—The expanded thin-walled vasa deferentia packed with sperm course alongside the pharynx near the posterior end of which they alter into thick-walled muscular accessory seminal vesicles (Fig. 12). These, after reaching a level behind the male pore narrow, approach the median line, and fuse to a narrow duct, the common vas deferens. This runs anteriorly penetrating into a round somewhat muscular organ which Wheeler considers the penis. It is, in fact, the prostatic vesicle and this mistake accounts for Wheeler's inability to find such a vesicle. It is not, to be sure, a very typical prostate. It has an excessively thick wall, containing muscle fibers coursing parallel to the surface contour and in the center a small area of granule glands radiating around the central small ejaculatory duct. The granule glands are best seen in frontal section (Fig. 12) as they are oriented parallel to such a section. Scattered glands also seem to extend into the thick wall of the prostate vesicle. After passing through the glandular region the ejaculatory duct terminates in the base of the stylet which constitutes the entire penis (Fig. 13). It is directed ventrally in the available specimens, extending into the male atrium. The latter has quite a muscular wall and is lined by an extremely tall columnar epithelium which bulges from the genital pore (Fig. 13).

It will be seen from the foregoing description that the male apparatus of *H. inquilina* accords completely with that found in other members of the genus. The vasa deferentia form accessory seminal vesicles, there is no true seminal vesicle, and the prostate vesicle bears directly the penis stylet without the intervention of any penis papilla proper.

The female copulatory apparatus consists simply of the vagina which extends dorsally from the genital pore receiving the secretion of the thickly strewn cement glands. The vagina is somewhat muscular, and lined by tall slender epithelial cells. After making a backward bend, the vagina constricts and beyond this constriction the shell glands cease and the lining epithelium alters to large vacuolated cells. This portion of the vagina resembles histologically a Lang's vesicle but morphologically is not such since the uteri open into its ventral end (Fig. 13).

Distribution.—*Hoploplana inquilina* has been recorded only from the vicinity of Woods Hole where it inhabits the mantle cavity of the large gastropod *Sycotypus*.

FAMILY PLANOCERIDAE Lang 1884 (EMEND. BOCK 1913)

Definition.—Schematommata with a cirrus instead of a penis; cirrus lined with spines, hooks, or ridges eversible to the exterior; with tentacles; with tentacular and cerebral eyes; copulatory complexes immediately behind the pharynx; with true or accessory seminal vesicles; prostate vesicle free or interpolated.

GENUS GNESIOCEROS DIESING 1861²

Syn. *Pelagoplana* Bock 1913.

Definition.—Planoceridae with wedge-shaped pellucid bodies; with tentacles containing eyes; cerebral eyes also present; with a true seminal vesicle and interpolated prostatic vesicle; cirrus armed with parallel toothed bands; vagina with a powerful musculo-glandular fold; Lang's vesicle transverse. Type, *Gnesioceros sargassicola* (Mertens) 1833.

PLATE IV

FIG. 12. Frontal view of the vasa deferentia and prostate vesicle of *Hoploplana inquilina*, showing area of granule glands in the center of the vesicle around the ejaculatory duct.

FIG. 13. Sagittal view of the copulatory apparatus of *Hoploplana inquilina*.

FIG. 14. *Gnesioceros verrilli*, dorsal view, whole mount, Woods Hole specimen.

² In 1861 Diesing created the genus *Gnesioceros* for two species; "*Planaria*" *pellucida* and "*Planaria*" *sargassicola* both described by Mertens in 1833. *Planaria pellucida* belongs to the genus *Planocera* and was removed to that genus in 1844 by Oersted. Diesing did not indicate which of the two species he considered typical of the genus *Gnesioceros*. I hereby remove *pellucida* from the genus and declare *sargassicola* to be the type of *Gnesioceros*, thus making the genus valid.

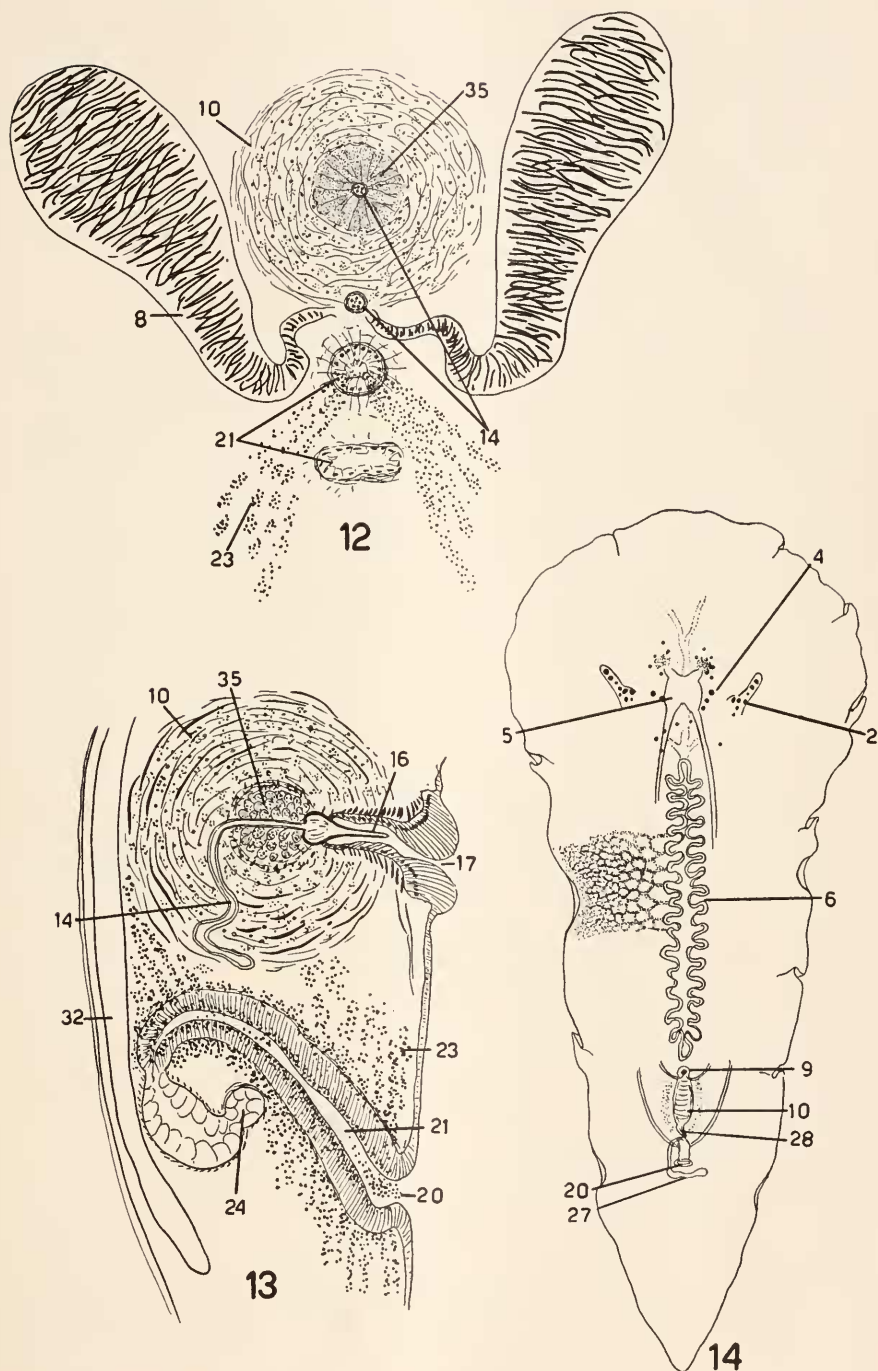


PLATE IV

GNESIOCEROS SARGASSICOLA (MERTENS) 1833

Syn. *Planaria sargassicola* Mertens 1833.

Stylochus sargassicola Ehrenberg 1836.

Planocera sargassicola Oersted 1844.

Stylochus pelagicus Moseley 1877.

Gnesioceros mertensi Diesing 1861.

Stylochus sargassicola (Mertens) Lang 1884.

Stylochoplana sargassicola (Mertens) Graff 1892.

Pelagoplana sargassicola (Mertens) Bock 1913.

This is the common polyclad of the Sargassum found on the floating weed in various parts of the world, common in the Gulf of Mexico, Caribbean, and North Atlantic. I took several specimens alive from the Sargassum at Bermuda and Burkenroad collected hundreds of specimens during an expedition to study the 'biology of Sargassum inhabitants. Alive the animal is pellucid with small brown spots and an expanded anterior end tapering to a pointed posterior end. It has been figured and described by von Graff (1892) and I have given an account of the structure of the cirrus (Hyman, 1939). A specimen of this species was taken from the Sargassum in Vineyard Sound, August 3, 1938.

GNESIOCEROS VERRILLI, NEW NAME

Syn. *Imogine oculifera* (Girard) Verrill 1892.

(not *Imogine oculifera* Girard 1853).

In 1882 Verrill found in Quisset Harbor a single specimen of a polyclad which he assigned to Girard's species *Imogine oculifera*. This identification is clearly erroneous since Girard plainly states that *Imogine oculifera* has a band of eyes completely encircling the margin and hence is a stylochid while Verrill's figure plainly shows a planocericid. Two vials of specimens were obtained from Mr. Gray which I am confident are identical with Verrill's specimen. Examination of these animals proved that they belong in the genus *Gnesioceros*. As it is necessary to give a specific name to Verrill's species, I propose to call it *verrilli*.

Description.—*G. verrilli* is very similar in all respects to *G. sargassicola*. The graceful body is anteriorly expanded (Fig. 14), being widest at about the level of the brain, and from there tapers gradually to the pointed posterior tip. The species is small, around 6-8 mm. in length. The preserved specimens were colorless but Verrill gives the color as carmine red. As this color was stated, however, to be limited to the intestinal branches, it is nearly certain that it resulted from

ingested food and that the animal is in fact, like *G. sargassicola*, pellucid with small brownish marginal spots. There are two elongate nuchal tentacles, each containing several eyes, most of which are in the tentacle bases. Between the tentacles, extending some distance behind and in front of them, are two loose elongate groups of cerebral eyes, of about 8-12 eyes each (Fig. 14). From the long, narrow, slightly ruffled pharynx a rich net of anastomosing intestinal branches radiates to the periphery.

The copulatory complexes behind the pharynx are very similar to those of *G. sargassicola* which have been described by Graff, 1892, and Hyman, 1939. The vasa deferentia enter separately the ventral angles of the pyriform seminal vesicle (Fig. 15) which ascends and narrows to the ejaculatory duct opening into the anterior end of the prostate vesicle. The latter is an elongate structure divided into chambers by cross-partitions and covered with a thick muscular coat which operates the cirrus. The prostate vesicle continues directly into the cirrus, a curved beak-like structure composed of hard yellow material, presumably not chitin but an albuminoid. The structure of the cirrus was described and figured in another place (Hyman, 1939) and hence a brief statement will be made here. The cirrus possesses a median groove and thus resembles a conch shell. It is made of parallel toothed bands (Fig. 16) which can be pulled into the interior along the groove by the action of the retractor muscle fastened along one side of the prostate vesicle. The protractor muscle on the other side of the prostate vesicle is attached to the central part of the bands. When it contracts, it pulls the bands to the outside where they take a horizontal course. The cirrus is situated in a pocket which continues into the male atrium and so to the male genital pore.

The female genital pore is shortly behind the male pore. From it the ciliated, slightly muscular vagina extends dorsally, then curves backward and ventrally and receives the uteri. Beyond this union the female canal continues as the stalk of Lang's vesicle and opens into the latter. Lang's vesicle is unique in the genus *Gnesioceros* in taking a transverse course, so that it embraces the rear and sides of the female genital pore in a somewhat crescentic shape. The genus is further notable for the presence in the vagina of a powerful musculo-glandular fold, consisting of a heavy muscle mass to which are attached numerous gland cells. In *G. sargassicola* this fold is ring-shaped, completely encircling the vagina; but in *G. verrilli* it is well-developed only in the anterior wall of the vagina, the side facing the cirrus, and but slightly present and more diffuse in the posterior vaginal wall (Fig. 15). The epithelium over the main muscle mass is reduced to a cuticularized membrane. In *G. sar-*

gassicola the vaginal epithelium from the musculo-glandular fold to the genital pore is also cuticularized and thrown into lengthwise ridges; but this is not the case in *G. verrilli*.

These differences in the vaginal structure constitute the chief distinctions between *G. sargassicola* and *G. verrilli*. Other differences are: the pharynx appears to be narrower and less ruffled in *G. verrilli* than in *G. sargassicola* and the prostate vesicle narrower and longer relative to the cirrus region in the former than in the latter.

Neotype.—It has seemed desirable to designate a neotype in the form of a whole mount deposited in the museum at Woods Hole; and a set of serial sections is also presented to this institution.

Distribution.—Taken from the eel grass, Devil's Foot Island, Woods Hole, Mass., December, 1930 and October 28, 1931; also found by Verrill in Quisset Harbor, Buzzard's Bay, on sandy bottom in four or five fathoms, September 4, 1882.

SUBORDER COTYLEA LANG 1884

Definition.—Polyclads with a sucker behind the female genital pore (a few exceptions); pharynx ruffled to tubular; copulatory complexes generally in the anterior half of the body; prostatic vesicle, when present, always free; uteri generally behind the female genital pore; tentacles when present of the marginal type; eyes on the anterior margin, on the tentacle bases when these are present.

FAMILY EURYLEPTIDAE LANG 1884

Definition.—Cotylea with anteriorly directed tubular pharynx; male apparatus below or immediately behind the pharynx, directed forward, with a free prostate vesicle and armed with a stylet; with or without uterine glands; tentacles vary from well-developed pointed marginal folds to none; with paired cerebral clusters of eyes and paired marginal clusters which are on the tentacles when these are present.

GENUS EURYLEPTA EHRENBURG 1831 (EMEND. LANG 1884)

Definition.—Euryleptidae with well-developed pointed tentacles; main intestine with very few (up to about five) lateral branches; male

PLATE V

FIG. 15. Sagittal view of the copulatory apparatus of *Gnesioceros verrilli*.

FIG. 16. Prostate vesicle and cirrus of *Gnesioceros verrilli*.

FIG. 17. Tentacles and eye distribution of *Eurylepta maculosa*, specimen collected by Verrill.

FIG. 18. Sagittal section of the same specimen as Fig. 17, showing pharynx and female copulatory apparatus; because of damage the male apparatus, to be expected immediately behind the pharynx, is missing.

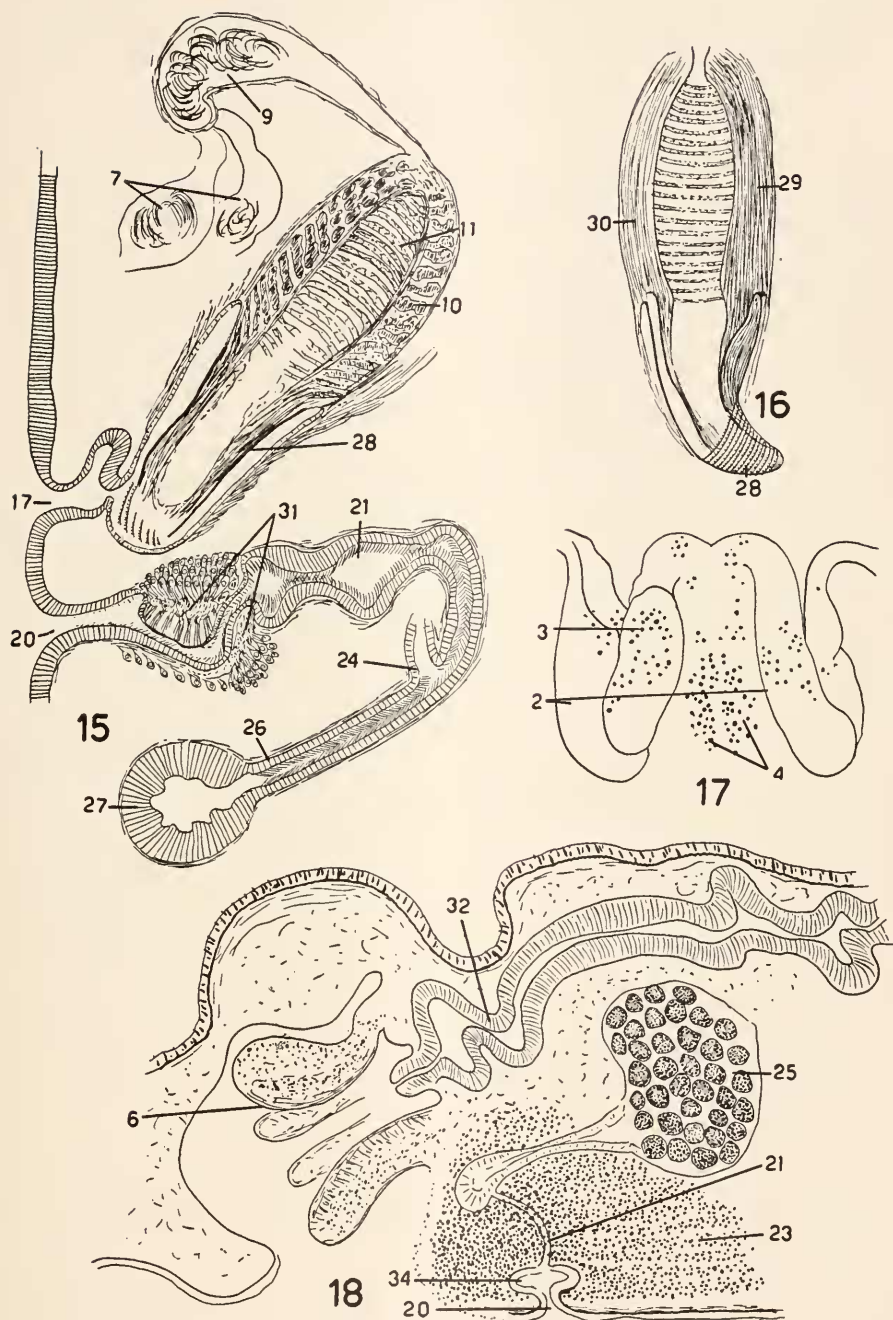


PLATE V

apparatus beneath the posterior end of the pharynx; uterine glands mostly one pair or none.

EURYLEPTA MACULOSA VERRILL 1892

A single specimen of this species was found at the Peabody Museum; after the eye arrangement had been drawn (Fig. 17) the animal was cut into sagittal sections but these were not very satisfactory. However, it seems desirable to describe the findings.

Description.—The species is said by Verrill to have a thin, changeable, elliptical or oblong body, 10–12 mm. long, with thin often undulated margin. The anterior margin is upfolded to make two fairly long bluntly pointed tentacles which bear eyes on their anterior faces (Fig. 17). There are, as also noted by Verrill, no eyes at or near the tentacle tips. There are elongated paired cerebral groups of eyes which are continued forward to the margin between the tentacles by scattered clusters of eyes. The preserved specimen was distinctly mottled with brown and white; Verrill gives the color as pale, yellowish or pinkish white, irregularly specked and mottled or veined with purplish or brown.

The serial sections show a typical euryleptid structure (Fig. 18) with short tubular pharynx directed forward. From the pharynx the main intestinal trunk runs backward in the middorsal line and has about three pairs of wide lateral branches, thus conforming to the genus *Eurylepta*. To either side of the intestinal trunk is a large thin-walled uterus stuffed with eggs. No uterine glands have been found. The region immediately behind the pharynx where the male copulatory apparatus would be expected is unfortunately broken and no trace of the male copulatory apparatus has been found. The female apparatus (Fig. 18) appears to be completely present. The female pore, shortly behind the pharynx, leads into a small expanded atrium from which a narrow vagina, receiving the innumerable cement glands, proceeds dorsally. The great mass of the cement glands almost obscures the female duct. The vagina widens into a small chamber from which a duct runs posteriorly and receives the uteri.

There appears to be little doubt that the species was correctly placed in the genus *Eurylepta*.

Distribution.—Found by Verrill on piles, in mud, and among algae at low tide at Woods Hole and vicinity, stated to be uncommon. The Peabody Museum specimen was labelled: *Eurylepta maculosa* V. cotype, mud, Woods Hole, Aug. 2nd.

Specimen.—The set of sections made from the specimen has been returned to the Peabody Museum.

Whole mounts or preserved specimens of most of the species described in this paper (except those belonging to the Peabody Museum) have been deposited in the Museum at Woods Hole. In some cases a set of serial sections has also been presented to this institution.

SUMMARY

1. *Stylochus zebra* (Verrill) 1882 is shown to have been correctly placed by Verrill in the genus *Stylochus*.

2. *Eustylochus ellipticus* (Girard) 1850 is shown to be a typical member of the genus *Stylochus*, its name thus becomes *Stylochus ellipticus*, and *Eustylochus* becomes a synonym of *Stylochus*.

3. *Notoplana atomata*, usually erroneously called *Leptoplana variabilis*, is the most common polyclad of the Maine coast.

4. *Prosthlostomum gracile* Girard 1850 has been rediscovered at Woods Hole. The later name *Euplana gracilis* which Girard gave to this species is valid and *Discoplana* Bock 1913 becomes a synonym of *Euplana* Girard 1893.

5. Specimens of *Leptoplana angusta* Verrill 1892 have been found at the Peabody Museum, Yale University. The species is placed in the genus *Stylochoplana* although it differs somewhat from the typical members of the genus. The name is then *Stylochoplana angusta* (Verrill).

6. As noted by Bock (1913), *Planocera inquilina* Wheeler 1894 must be transferred to the genus *Hoploplana* and the correct name of the species is *Hoploplana inquilina*. What Wheeler considered to be the penis is in reality the prostatic vesicle.

7. Two common and well-known Sargassum polyclads have been taken on the Sargassum in Vineyard Sound; these are *Hoploplana grubci* (Graff) 1892 and *Gnesioceros sargassicola* (Mertens) 1833. *Pelagoplana* Bock 1913 becomes a synonym of *Gnesioceros* Diesing 1861.

8. Another species of *Gnesioceros*, *G. verrilli*, new name, occurs around Woods Hole; it was seen by Verrill in 1882 and erroneously identified by him as *Imogine oculifera*.

9. A single specimen of *Eurylepta maculosa* Verrill 1892 was found at the Peabody Museum; some details of its anatomy are described.

ADDENDUM

Since this manuscript was sent to press there have appeared three articles on Atlantic coast polyclads by A. S. Pearse and associates (*Proc. U. S. Nat. Mus.*, 86, *Jour. Elisha Mitchell Sci. Soc.*, 54, and *Bull. Mt. Desert Is. Biol. Lab.* 1938). I am unable to agree with many of the identifications, taxonomic placing, and anatomical findings in these

articles but detailed criticism will be withheld until a study of Pearse's specimens now under way has been completed.

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